further research would be most useful were therefore mentioned in the hope that the members of the Glasgow Geological Society would investigate them.

The problem is of interest from its bearing upon the early geological history and geography of north-western Europe. The structure of western Europe has been dominated by the formation of three great mountain systems, each due to pressure usually from the south, and each having its younger rocks exposed mainly on the northern flanks of the chain. The youngest is the Alpine system, formed mainly in Upper Cainozoic times, and including the Pyrenees, Alps, Carpathians, &c. A somewhat similar mountain system, of which fragments remain in southern Ireland, Devonshire, Brittany, and Germany, had been formed in Upper Palæozoic times; from its analogy with the Altai Mountains of Asia, Suess has called its mountains the European Altaids. Still earlier, in later Archæan times, there was formed the first of these European mountain systems, of which fragments occur in northern Ireland, the Grampians, and Scandinavia. There are many interesting analogies between these old Grampians and the later Altaids and Alps. The old mountain system to which the Grampians belonged probably extended far westward into the North Atlantic, and to its influence may be attributed the desert climate of Scotland during the deposition of the Torridon Sandstone.

THE ETIOLOGY OF LEPROSY.

THE eighteenth report of the Board of Health on leprosy in New South Wales contains the usual careful clinical records of the features of the disease in the patients admitted during the year, as well as a record of all the cases occurring in the Commonwealth during 1908. No case of leprosy has ever been heard of in Tasmania. In the other States the disease occurs apparently most frequently in Chinese and in aboriginals, and is more frequent in northern than in southern territories.

An account is given of a systematic test of Prof. Deycke's "nastin" treatment. Nastin is a vaccine made from a leptothrix found in some recent Lepromata, and not from the bacillus lepræ. It is pronounced valueless, any beneficial result being assigned to the natural fluctuations in the progress of the disease; one or more cases of spontaneous cure are noted. For the rest, the report is remarkable for the scepticism the author, Dr. J. Ashburton Thompson, expresses on the etiology of leprosy and on the value of isolation as a preventive of transference of the disease.

It will be remembered that the International Congress at Bergen last year endorsed the view that the bacillus lepræ of Hansen was the etiological agent. Dr. Thompson's views are seemingly published as a protest, and, holding the views he does, it is gratifying to learn that Dr. Thompson recognises that, as the presiding and executive member of the central health authority to which the Leprosy Act is entrusted, he has a clearly defined duty to perform, and that he performs it, notwithstanding his thinking "the *mère idée* on which that law is based to be of doubtful utility," and his statement, "I can at all events safely assert that its validity has not been demonstrated." One would have thought that the success which has attended the practice of isolation in Norway during the past forty years afforded sufficient evidence of its value even to the most sceptical, for Hansen's prophecy some forty years ago that in 1920 there would be no leprosy in Norway is in more than a fair way of being fulfilled.

HELIUM IN AIR AND MINERALS.

AN interesting paper on the occurrence of helium in the air of Naples and in minerals from Vesuvius is published by Prof. A. Piutti in the *Rendiconto* of the Royal Society of Naples (third series, vol. xv., p. 203). It is well known that in 1881 Prof. Palmieri read a paper before the same academy in which he claimed to have recognised the characteristic line D_3 of helium in the flame spectrum obtained by heating in a Bunsen flame "an amorphous, buttery substance of a yellow colour which was found as a sublimate on the edge of a fumarole near the mouth of Vesuvius." This is generally accepted as the first discovery of terrestrial helium, although Nasini and Anderlini in 1906, on examining the flame spectrum of a large number of volcanic incrustations, failed to recognise the presence of helium in any of the specimens they examined under the conditions described by Palmieri.

Prof. Piutti has now investigated with especial care, and by an ingenious method, the gas evolved on heating several Vesuvian minerals. The gas was expelled by heating the mineral in a quartz tube connected, through a three-way cock, with a Plücker tube, a Gaede air-pump, and a glass bulb containing cherry-stone carbon, which could be cooled to $-192°$ C. The latter served to absorb nitrogen and inert gases other than helium. All air was first entirely removed from the apparatus by the Gaede pump, special care being taken to ensure its complete absence prior to heating the mineral and during the course of the experiments. When the carbon is cooled by liquid air and the vacuum applied, any nitrogen present is first absorbed by the carbon, and the lines of argon and neon appear until the kathode space is formed. At this point, if even the smallest trace of helium is present, the D_3 line is seen distinctly by the side of the sodium lines. Control experiments showed that 0·073 cubic mm. could be detected in the apparatus employed. Helium can also be detected in the same way in 3·5 c.c. of ordinary air.

The examination of several radio-active forms of sanidinite from Vesuvius showed that the radio-activity was due to particles of zircon contained therein. This zircon was found to evolve helium, and other samples of zircon from different localities, Italian and otherwise, were also found to contain helium in varying proportions. No relation could, however, be traced between the proportion of helium and the radio-activity or density of the samples. The Vesuvian zircon had the highest radio-activity, but the proportion of helium was relatively low.

THE SUGAR INDUSTRY IN HAWAII.[1]

HAWAII and its associated islands, Maui, Oahu, Kauai and others, form a volcanic group in the Pacific 20° north of the equator, largely devoted to sugar production. In 1895 the Sugar-planters' Association established an experiment station at Honolulu, and some five years later the islands were annexed by the United States. The enormous importance of these two events is reflected in the statistics for sugar production :—

	Hawaii	Maui	Oahu	Kauai	Total
1895	61,643	27,735	17,433	42,816	149,627 tons
1896	109,259	29 097	35,782	51,650	225,828 ,,
1900	115,224	57,347	53 625	63,348	289,544 ,,
1901	134,618	58,349	99,534	67,537	360,038 ,,
1905	126,405	100,434	123,095	76,314	426,248 ,,
1908	180,159	122,629	137,013	81,322	521,123 ,,

The increase during the fourteen years has been from less than 150,000 tons to more than 520,000 tons, and detailed statistics show that the produce per acre, as well as the total acreage, has increased.

Practically all phases of the sugar industry are dealt with at the experiment station. Varieties of canes are tested, seedlings are raised and examined, and the effect of change of variety is investigated, the object being always to obtain plants more prolific, better adapted to the local surroundings, and more resistant to the local diseases or insect pests than those at present grown. Considerable attention is paid to insect pests, which naturally do an increasing amount of damage as cultivation becomes more and more intense. Methods of working up the sugar are also studied, the chemical and milling problems involved are gone into, nothing within the power of the staff and likely to benefit the planters being omitted.

In consequence there is a constant tendency to economy in production; thus in the early years fertilisers were often applied without any reference to the specific requirements of the crop or the general deficiencies of the soil; now, however, these, and also climatic considerations, are taken into account, and the staff are able to give useful definite information as to the mixture of fertilisers required.

1 Tropical Life, No. 2, vol. vi., 1910. Bulletins of the Sugar-planters Associations, Hawaii.

Relatively large quantities of nitrogenous and of potassic manures are found necessary, phosphates being less needed; to meet this demand, potash salts and nitrate of soda are now imported in quantity. Ten years ago there was practically no importation of these manures.

A certain amount of the land has to be irrigated, especially that occurring on the leeward side of the high land forming the interior of the island. On the windward side, however, the rainfall is higher and irrigation is not necessary. On the island of Hawaii itself most of the plantations are unirrigated, but on the other islands irrigation is very general. Here, also, useful help has been given by expert engineers in ascertaining the cheapest effective way of obtaining the necessary water.

NATURAL SCIENCE IN BENGAL.

THE annual report of the Asiatic Society of Bengal for the year 1909 has now been published. We notice that the society celebrated its 125th anniversary on January 15, 1909. The celebration took the form of an evening reception held in the Indian Museum. Many scientific, archæological, philological, and historical exhibits were shown, illustrating the progress and activities of the society. The council awarded the Barclay memorial medal for 1909 to Lieut.-Colonel David Prain, F.R.S., I.M.S. (retired), in recognition of his biological researches.

The total number of contributions to the society under the heading mathematics and the natural sciences was seventeen. Commenting on these, the report points out that Mr. Hooper's paper on *Tamarisk manna* shows that the chief sugar in it is not mannite, but a saccharose. Babu Bidhu Bhusan Dutta, in a contribution on the constituents of the roots of *Arisaema concinnum*, Schott, and *A. speciosum*, Mart., shows that these two famine foods contain much nutriment, chiefly starch. Mr. B. L. Chaudhuri directed the attention of the society to the mosquito-larvæ eating propensity of fish of the genus Haplochilus, and asked for cooperation in making further observations. Several species of this genus of small fishes are voracious feeders on the larvæ.

Babu Nibaran Chandra Bhattacharjee directed attention to the way in which *Marsilia quadrifolia* fruits only when the water in which it has been growing recedes from it and leaves it dry. Mr. H. Martin Leake's paper on Indian cottons is of importance. His object is to breed early cotton suitable for cultivation at Cawnpur, with the good lint of the slow-maturing cottons; he has observed the characters in bud development which lead to early or late maturity in order to recognise such as combine with the desirable quantities in the lint. Mr. E. P. Stebbing, in a paper on the Loranthus parasite of the Moru and Ban oaks (*Quercus dilatata*, Lindl., and *Quercus incana*, Roxb.), shows how destructive the parasite is to these oaks in the neighbourhood of Naini Tal and in Kumaon. Sir George King's "Materials for a Flora of the Malayan Peninsula" has been continued. Accounts of the orders Gesneraceæ, by Mr. H. N. Ridley, and Verbenaceæ, by Mr. J. Sykes Gamble, have been received. Mr. Burkill has diagnosed two varieties of the lemon oil grass, *Cymbopogon Martini*. Prof. P. Brühl has contributed a paper on recent plant immigrants into Bengal; 234 species are named by him; their origin is discussed and the causes of their introduction. America supplied 54·7 per cent. of these immigrants.

THE DEVELOPMENT OF ELECTRICAL POWER AT NIAGARA FALLS.[1]

THE development of electrical power at Niagara Falls has long attracted widespread attention and interest. Since the first installation upon the American side, descriptions and discussions of its works and methods have been granted a conspicuous place in technical records and the scientific Press, but the fact is apparently less known that there now exist at Niagara four more installations, each larger than the pioneer plant, and one at least differing from it to a very marked degree in the method in which the turbines are employed and coupled to the electrical generators.

The author, having paid a visit to Niagara in December, 1907, when exceptional opportunities were afforded him of inspecting the whole plant of the Ontario Power Company, takes the present opportunity of recording the following notes, which may supplement the knowledge of the subject hitherto available, especially so as, after the completion of these notes, correspondence took place with the Ontario Power Company with the object of eliciting further information, and photographs were received illustrating the operations of the company.

Scheme.—Briefly outlined, this company's development comprises the taking of water from the Upper Niagara River above the Horseshoe Fall, leading it through pipes and penstocks to turbines in a station below the Fall, and there utilising its energy for the generation of electricity, which is transmitted to a second station on the hill above, and thence distributed. There is a fall in level of 55 feet in the rapids above the Horseshoe Fall, and to take advantage of this the headgates are placed just above the rapids. From the headgates three great steel and concrete tunnels or conduits, laid below the surface of the Victoria Park, will convey nearly 12,000 cubic feet of water per second to the top of the cliff above the power-house, and just beyond the Fall. Thence it will pass through twenty-two steel penstocks in shafts and tunnels down and out through the cliff to an equal number of horizontal shaft turbines in the power-house below, which is situate on the water edge immediately at the foot of the Horseshoe Fall. From the generators, the electrical cables will pass through tunnels to the twenty-two banks of switches, transformers, and instruments in the distribution station on the hill above, and thence to the transmission lines beyond, the whole installation, when complete, being capable of an output of more than 200,000 horse-power.

The intake works for the entire 200,000 horse-power are now finished. One of the three main conduits is completed and in use, while the portals and headworks for the second and third tunnels are completed, and a portion of the excavations made. Six of the twenty-two penstocks are completed, and with their turbine-sets are at work, and at the time of the author's visit the seventh was practically completed. The distribution-station building is complete for the switchboard of the entire twenty-two units, for the transformers of eight, and the other apparatus of fourteen units, and is well ahead of the developments in the power-house.

The most important engineering features wherein this latest company differs from its predecessors are the arrangement of intake works, the design of main conduit and spillway, the horizontal shaft turbine units, the symmetry of arrangement of the whole, the centralisation of control, and the protective isolation of the various apparatus.

Particulars of Niagara River and the Falls.—The total drop in the Niagara River in its course of thirty-six miles between Lake Erie and Lake Ontario is 326 feet, of which 216 feet is in the Falls and the rapids immediately above them.

The American Fall is 167 feet high and 1000 feet in width, while the Horseshoe Fall is 159 feet high and 2600 feet in width. The greatest depth of the river immediately below the Falls is about 192 feet. It is estimated that an average of 222,400 cubic feet of water pass over the Falls each second. This is 25,000,000 tons per hour, or about one cubic mile a week, and represents a kinetic energy of nearly 5,000,000 horse-power. At the headworks of the Power Co. the river is 3400 feet wide, and flowing at an average velocity of about 8 feet per second.

Intake.—These works have been placed and designed, not only to take advantage of the additional height of the rapids as mentioned above, but also with special reference to the ice difficulties, which have been the limiting factor in the success of Niagara power. Cake-ice in enormous quantities floats down for weeks at a time from the Great Lakes, and mush-ice is also formed in the rapids, primarily by the freezing of spray and foam, and secondarily by the disintegration of cake-ice. The latter trouble is avoided, since the intake is in the smooth water just above the

[1] From a paper entitled "An Account of a Visit to the Power Plant of the Ontario Power Co. at Niagara Falls," read before the Institution of Mechanical Engineers on January 7, by Mr. C. W. Jordan.